The Inchworm Deep Drilling System For In Situ Investigations of Martian Subsurface Aquiferous Zones. T.Myrick[12], S.Frader-Thompson1[13], J. Wilson[14], S. Gorevan[15], [1]Honeybee Robotics, 204 Elizabeth Street, New York, NY 10012, [2]Myrick@HoneybeeRobotics.com, [3]Frader-Thompson@HoneybeeRobotics.com, [4]Wilson@HoneybeeRobotics.com, [5]Gorevan@HoneybeeRobotics.com

In reviewing the Astrobiology Roadmap [1] and its objectives, as well as the goals and investigations sanctioned by the Mars Exploration Program Analysis Group (MEPAG)[2], an explicit need emerges for a vehicle to bring instrumentation to the subsurface water ice deposits and horizontal aquiferous zones of Mars. Recent findings indicating that water in the liquid phase on Mars may exist at 100 meters or more below the surface points out the need to obtain a means of practical deep subsurface access. The Inchworm Deep Drilling System (IDDS) addresses that explicit need. The IDDS is a low mass, novel subsurface access technology that is currently being developed with the support of NASA HQ. The IDDS is endowed with the potential to drill tens to hundreds of meters if tethered to a base platform on the surface, or if un-tethered, could access locations several kilometers below the surface of Mars. Yet the IDDS does not require the onerous mass and power of terrestrial drilling systems. An un-tethered, self-contained IDDS may utilize Radioisotope Thermoelectric Generators (RTGs) for fully autonomous operation at depths below a few to several hundred meters. By keeping one set of borehole wall shoes firmly secured to the borehole wall, on either the forward or aft section, the other section is able to expand or retract (like an inchworm), allowing the IDDS to drill into competent rock or ice and traverse the borehole. This method of locomotion is independent of gravity and allows the IDDS, tethered or un-tethered, to traverse the borehole to the surface for cuttings removal, external sample analysis, or to accommodate sample return. The IDDS is capable of delivering an instrument suite to candidate subsurface targets to perform in situ analyses of biogenic mineralogy and possible liquid water zones in and around assumed aquiferous seepage channels, paleoenvironments [3], and water ice deposits at moderate depths of 100 meters or more. The instrument suite could include the combination of mission specific borehole analytical instruments, such as microscopic and multi-spectral cameras and various spectrometers, with innovative stratigraphy-maintained sampling and sample manipulation mechanisms, such as a Mini-Corer-like coring bit and a method of delivering cuttings and cores to the onboard instrumentation or storing the samples for delivery to the surface. Honeybee Robotics believes the drilling mechanisms and subsystems, including the instrument suite, could be integrated into a compact and robust system (on the order of two meters long and twelve centimeters in diameter, however, the size depends heavily on the number and type of instruments and the sample acquisition and delivery methods required). The proposed technology maturation is funded under NASA's Planetary Instrument Definition and Development (PIDD) and Astrobiology Science and Technology for Exploring Planets (ASTEP) programs.

References: [1] Astrobiology Roadmap, (2002), [2] Scientific Goals, Objectives, Investigations, and Priorities: *2003*, MEPAG, (2003), [3] Malin, M.C. and K.S. Edgett, 2000, Evidence for Recent Groundwater Seepage and Surface Runoff on Mars, *Science* 288: 2330-2335.